CLAIMS

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1. A semiconductor device comprising:

a channel of a first conductive type formed on a surface layer of a semiconductor substrate;

a source and a drain of a second conductive type formed on both sides of the channel;

a gate insulation film with a first relative permittivity formed at least on said channel directly or through a buffer insulation film;

a gate electrode formed on said gate insulation film; and

a side insulation film formed at least on a side of said gate insulation film and having a second relative permittivity which is smaller than the first relative permittivity, wherein

when assuming that an area of said gate insulation film, which is adjacent to said surface layer on a gate electrode side, is S1, and an area thereof, which is adjacent to said surface layer on said channel side, is S2, the area S1 is larger than the area S2.

2. The semiconductor device according to claim 1, wherein the first permittivity is 20 or more.

3. The semiconductor device according to claim 1, wherein the area S2 is 1.5 times or more as large as the area S1.

4. The semiconductor device according to claim 1, wherein, a width of said gate insulation film on the

channel side is smaller than a width of said gate insulation film on the gate electrode side in a length along a channel width direction of said gate insulation film.

5. The semiconductor device according to claim 1, wherein a sectional shape along a direction of the source-drain of said gate insulation film is one of tapered shape, a trapezoid, a sector, and a stair.

6. The semiconductor device according to claim 1, wherein a sectional shape along a direction of the source-drain of said gate insulation film from the gate electrode to the predetermined distance is a rectangle, and is one of a tapered shape, a trapezoid, a sector, and a stair on channel side therefrom.

7. The semiconductor device according to claim 1, wherein said first gate insulation film is a high dielectric film or a ferroelectric film including a composition or an element of one of Ta_2O_5, $Sr_2Ta_2O_7$, TiO_2, $SrTiO_3$, $BaTiO_3$, $CaTiO_3$, $Ba_xSr_{1-x}TiO_3$, $PbTiO_3$, $PbZr_xTi_{1-x}O_3$, $SrBi_2Ta_2O_9$, $SrBi_2(Ta_xNb_{1-x})_2O_9$, or $Bi_2(Ta_xNb_{1-x})O_6$.

8. The semiconductor device according to claim 1, wherein said buffer insulation film includes one of SiO_2, Si_3N_4, NO, TiO_2, $SrTiO_3$, MgO or CeO_2.

9. A semiconductor device comprising:

a channel of a first conductive type formed on a surface layer of a semiconductor substrate;

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a source and a drain of a second conductive type formed on both sides of the channel;

a gate insulation film with a first relative permittivity formed at least on said channel directly or through a buffer insulation film;

a gate electrode formed on said gate insulation film; and

a side insulation film formed at least on a side of said gate insulation film and having a second relative permittivity which is smaller than the first relative permittivity, wherein

an electric flux density in said gate insulation film on the channel side is closer than that on the gate electrode side.

10. A semiconductor device comprising:

a plurality of first MOS type transistors each comprising a first channel of a first conductive type formed on a surface layer of a semiconductor substrate, a first source and a first drain of a second conductive type formed to both sides of said first channel, a first gate insulation film with a first relative permittivity formed at least on the first channel directly or through a buffer insulation film, a first gate electrode formed on said first gate insulation film, and a first side insulation film formed at least on side of said first gate insulation film and having a second relative permittivity which is smaller than

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the first relative permittivity; and

a plurality of second MOS type transistors each comprising a second channel of a first conductive type formed on a surface layer of said substrate, a second source and a second drain of a second conductive type formed on both sides of said second channel, a second gate insulation film with the first relative permittivity formed at least on said second channel directly or through a buffer insulation film, a second gate electrode formed on said second gate insulation film, and a second side insulation film formed at least on side of said second gate insulation film and having a second relative permittivity which is smaller than the first relative permittivity, wherein

when a cross-section on said first channel side of said first gate insulation film is assumed to be S1, a cross-section on said first gate electrode side is assumed to be S2, a cross-section on said second channel side of said second gate insulation film is assumed to be S3, and a cross-section on said second gate electrode side of said second gate insulation film is assumed to be S4, a condition of:

$$S2/S1 > S4/S3$$

is satisfied.

11. The semiconductor device according to claim 10, wherein the first permittivity is 20 or more.

12. The semiconductor device according to claim 10,

a voltage applied to the first gate electrode is lower than a voltage applied to the second gate electrode.